

Exp 3: Hardness test.

Hardness: is Resistance to indentation or scratching.

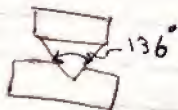
- Objectives: To find Vicker Hardness # (VHN) for steel specimen
To observe relation between depth & Hardness #.

The smaller the indentation \rightarrow harder the material

Ductility of work-piece is larger than ductility of Indenter

Pyramidal shape Indenter

work piece



$$\checkmark VHN = 1.854 \frac{P}{d^2} \quad \text{level}$$

$$\checkmark d = \frac{d_1 + d_2}{(0.1)(2) \text{ (Total magnification)}}$$

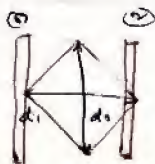
VHN \uparrow \rightarrow Hardness \uparrow

② Brinell

Indenter is sphere



* Hardness the specimen grinded & polished no etching



(11)

lead	d. (mm)	d. (mm)	d. (mm)
gf	25	25	
100		38-5	
200	38-5		
500	65	68-5	
1000	99-5	96	



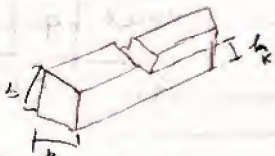
Exp. 5). Impact Test.

obj

1. Impact Energy.
2. Toughness.
3. ductile or Brittle.

I_k = Impact energy = $mgh_u - mgh_f$

$$a = \frac{AK}{b h_k}$$



a : Resistance to impact

I_k : striking energy (Joule) / \odot Impact energy

a : width of specimen.

b : thickness from center of notch. (mm)

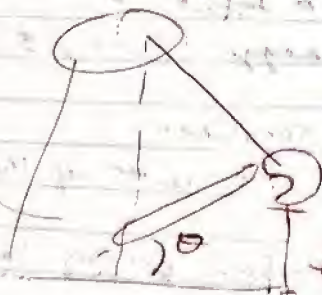
ductile: deform Energy larger than Brittle.

Brittle:

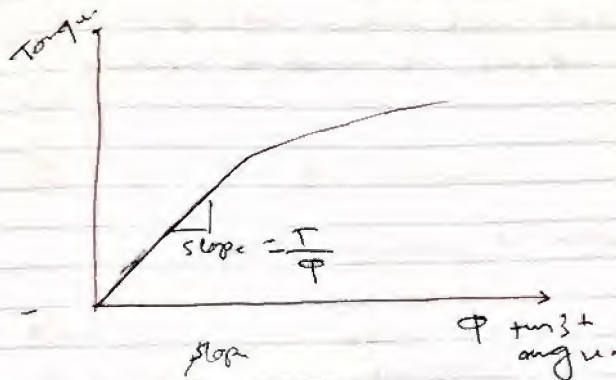
Match $\frac{1}{2}$
 Chery: $\frac{1}{2}$
 Izadi: Same.

when 2 or more bodies, collision
 high force or shock. Applied for
 short period of time.

	b (m)	b_r (m)	AK (J)
Steel	9	6	40
Al	6	4	12



Exp. 6. Torsion Test -



① $G = \frac{T}{\phi} \frac{L}{J}$ L → Specimen

modulus of rigidity.

$$J = \frac{\pi}{2} R^4$$

② Max Shear stress.

(15)

Exp 17. Heat Treatment.

Heating up steel a very high temp then cooling it down at specific rate

- Obj.
1. Refine grain structure
 2. Relieve
 3. Increase hardness & Tough

Heat treatment effect. on Mecha properties \rightarrow Some item (not all).

- ↑
Mecha
1. hardness & Toughness
 2. Resistance to wear
 3. ~ ~ ~ Shock.
 4. Tensile strength

Grain size decreasing.

Annealing \rightarrow Normalizing \rightarrow Quenching
 \rightarrow tempering
 \rightarrow water

Hardness increasing

Q: What is the product of each heat process?

1) Annealing \rightarrow cooling furnace \rightarrow coarse pearlite

2) Normalizing \rightarrow cooling by Air \rightarrow fine pearlite

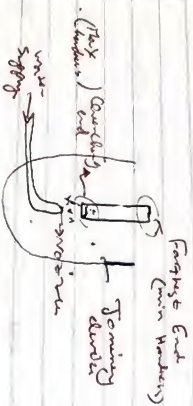
3) Quenching oil \rightarrow very fine pearlite
water \rightarrow martensite (hard & brittle)
fastest cooling rate & hardness as they.

Types of st. pt. original	d_1	d_2	$v_H \sim f = 1500 \text{ Hz}$

Expt 8: Hardability Test (Jominy End Quench, Jominy test)

Hardness: Resistance to scratching

Hardability: Measure in depth to which the specimen may ~~be~~ be hardened



by quenching it from a temp above A_{CC} (upper critical limit).
expected 727°C